

方案简介

本应用方案基于一款高集成度的峰值电流型反激电源控制器 VPC2188B，结合隔离功率变压器 VPQ18FF-72A、输出整流二极管以及必要的阻容元件，实现 18V-36V 输入，24V 输出的隔离稳压电源方案。本方案可实现全输入电压范围最大功率 72W 的输出能力，原副边隔离耐压不小于 1500VDC，同时具备欠压保护、可长期短路保护并自恢复等功能。本方案可应用在系统板需要实施电气隔离以达到安全和（或）抗干扰目的的相关场合。

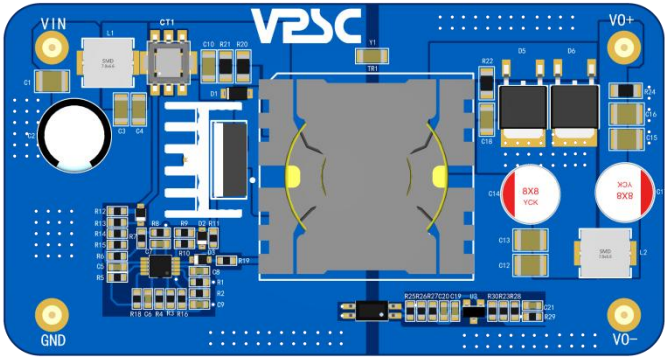
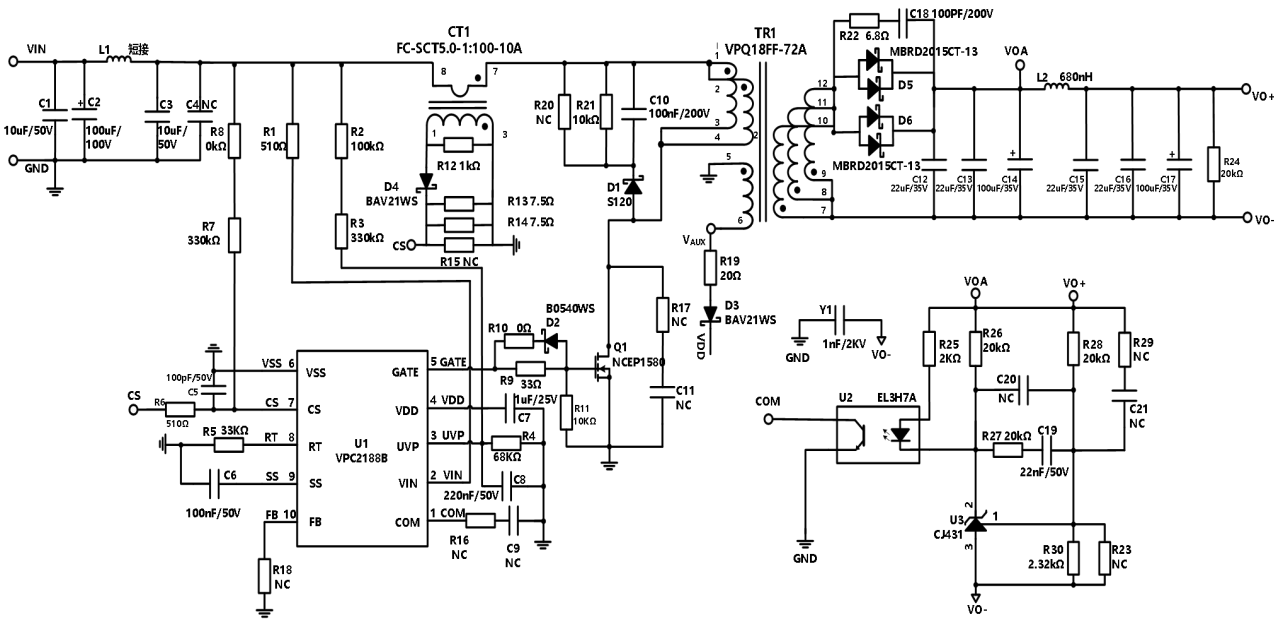


图 1: VPC2188B Demo 板(尺寸:90mm*48mm)

关键词：输入：18V-36V，输出 24V/72W，隔离电压：1500VDC，反馈方式：副边反馈-SSR

原理图



引脚功能说明

编号	功能	功能描述
1	VIN	电源输入端
2	GND	电源接地端
3	VO+	电源输出正
4	VO-	电源输出负

物料清单

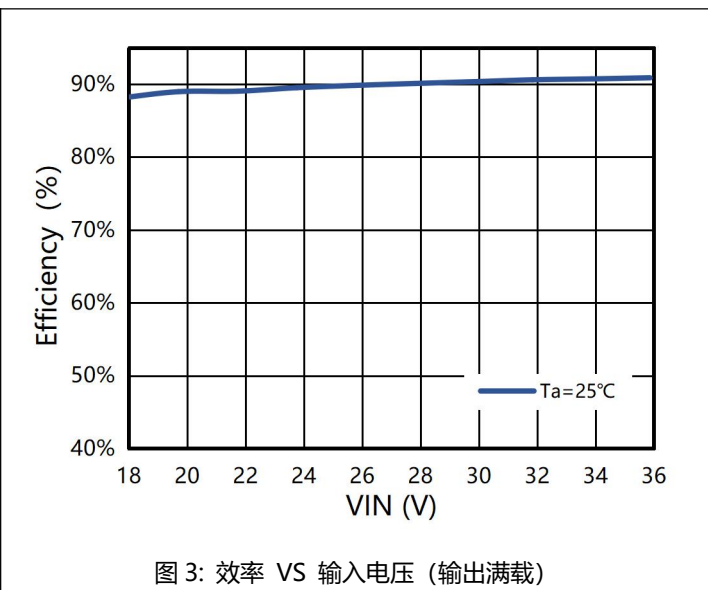
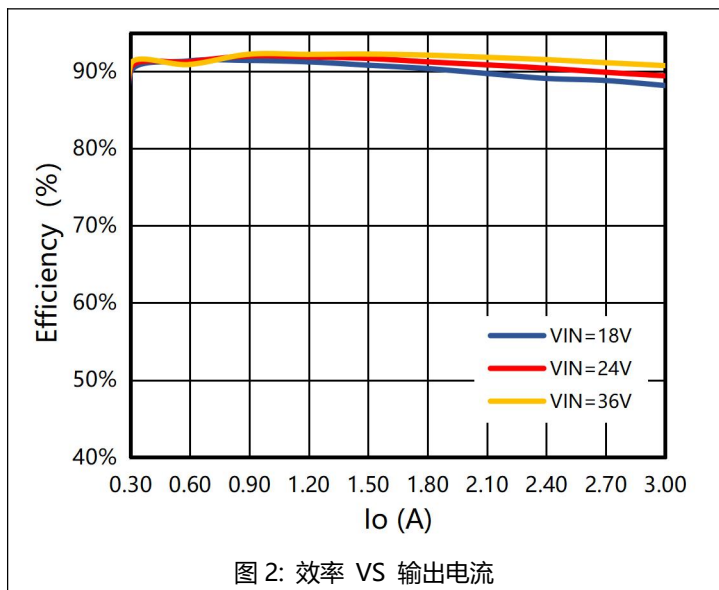
位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	100uF±20%/100V	D10xL16mm	01EC0961	KNSCHA
C3	10uF/50V-X7R	1206	CC1206KKX5R9BB106	YAGEO
C4	NC	-	-	-
C5	100pF/50V-X7R	0603	CC0603MRX7R9BB101	YAGEO
C6	100nF/50V-X7R	0603	AC0603KRX7R9BB104	YAGEO
C7	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C8	220nF/50V-X7R	0603	AC0603KRX7R9BB224	YAGEO
C9	NC	-	-	-
C10	100nF/200V-X7R	1206	CC1206KKX7RABB104	YAGEO
C11	NC	-	-	-
C12	22uF/35V-X5R	1206	CGA1206X5R226M350NT	HRE
C13	22uF/35V-X5R	1206	CGA1206X5R226M350NT	HRE
C14	100uF±20%/35V	D8xL11.5mm	35YXF100MEFC8X11.5	RUBYCON
C15	22uF/35V-X5R	1206	CGA1206X5R226M350NT	HRE
C16	22uF/35V-X5R	1206	CGA1206X5R226M350NT	HRE
C17	100uF±20%/35V	D8xL11.5mm	35YXF100MEFC8X11.5	RUBYCON
C18	100pF/200V-NP0	1206	CC1206JRNPOABN101	YAGEO
C19	22nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C20	NC	-	-	-
C21	NC	-	-	-
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
L1	短接	-	-	-
L2	680nH±20%/12A	SMD,5.4x5.2mm	MWSA0503S-R68MT	Sunlord
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	100KΩ±1%	0603	AC0603FR-07100KL	YAGEO
R3	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R4	68KΩ±1%	0603	RC0603FR-0768KL	YAGEO
R5	33KΩ±1%	0603	RC0603FR-0733KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R8	0KΩ±1%	0603	RC0603FR-070RL	YAGEO
R9	33Ω±1%	0603	RC0603FR-0733RL	YAGEO
R10	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R11	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R12	1kΩ±1%	0603	RC0603FR-071KL	YAGEO
R13	7.5Ω±1%	0603	RC0603FR-077R5L	YAGEO
R14	7.5Ω±1%	0603	RC0603FR-077R5L	YAGEO
R15	NC	-	-	-
R16	NC	-	-	-
R17	NC	-	-	-

R18	NC	-	-	-
R19	20 Ω ±1%	0603	RC0603FR-0720RL	YAGEO
R20	NC	-	-	-
R21	10K Ω ±1%	1206	RC1206FR-0710KL	YAGEO
R22	6.8 Ω ±1%	1206	RC1206FR-0751RL	YAGEO
R23	NC	-	-	-
R24	20K Ω ±1%	1206	RC1206FR-0720KL	YAGEO
R25	2k Ω ±1%	0603	RC0603FR-072KL	YAGEO
R26	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R27	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R28	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R29	NC	-	-	-
R30	2.32K Ω ±1%	0603	AC0603FR-072K32L	YAGEO
TR1	NP:NS:NA=10:8:5 Lp=12.8uH	PQ2620	VPQ18FF-72A	VPSC
Q1	N 沟道 150V 80A	TO-220	NCEP1580	NCE
D1	200V/1A	SOD-123FL	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	CJ
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	200V/0.2A	SOD-323	BAV21WS	CJ
D5	150V/10A	TO-252-3	MBRD20150CT-13	DIODES
D6	150V/10A	TO-252-3	MBRD20150CT-13	DIODES
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2188B	VPSC
U2	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT
U3	Vref=2.495V	SOT23-3	CJ431	CJ

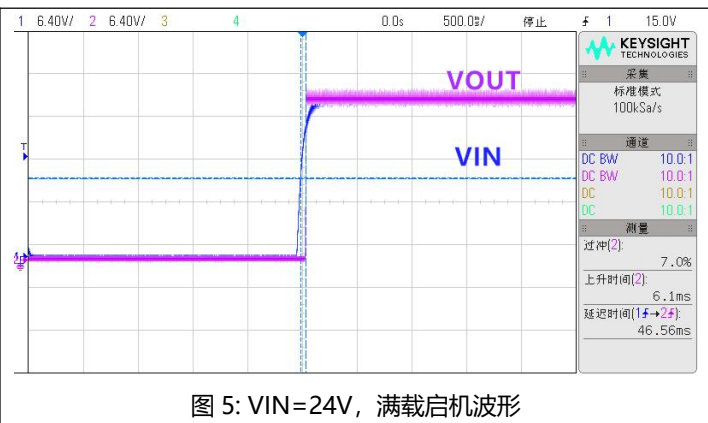
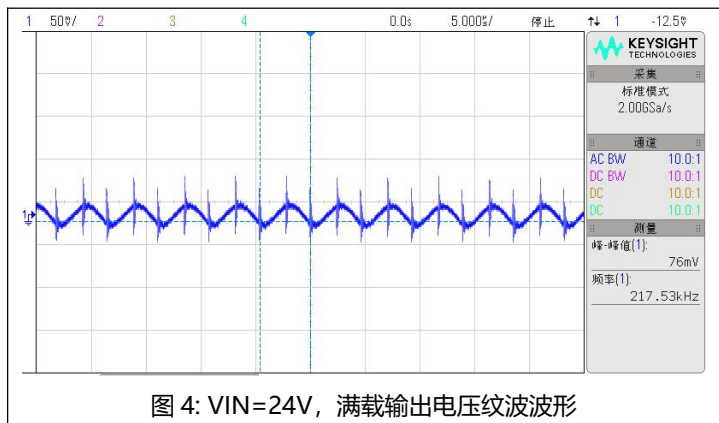
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	6	---	3370	mA
转换效率	VIN=24V, IO=3A	---	89.53%	---	%
纹波&噪声	VIN=24V, IO=3A	---	76	113	mV
输出电压精度	VIN=24V, IO=3A	---	0.5	---	%
线性调节率	VIN=18V-36V, IO=3A	---	0.5	---	%
负载调整率	VIN=24V, IO=3A	---	0.5	---	%
输出过流点系数	VIN=18V, IO=3A	---	1.37	---	倍
最大容性负载	VIN=18V, IO=3A	---	6800	---	uF
输入欠压保护	锁定电压	---	15.2	---	V
	恢复电压	---	16.5	---	V
短路保护	VIN=18V-36V	可长期保护, 自恢复			
工作温度	大于 70°C需降额使用	-40	---	85	°C
绝缘电压	原边短接 VS 副边短接	1500	---	---	VDC

关键性能指标测试结果

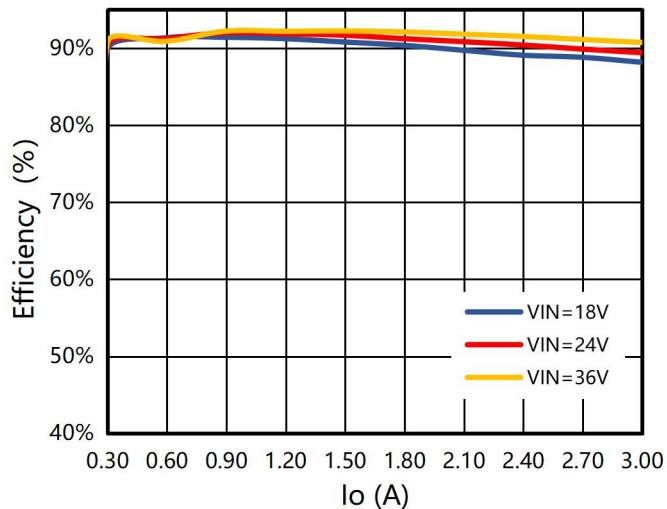


相关波形

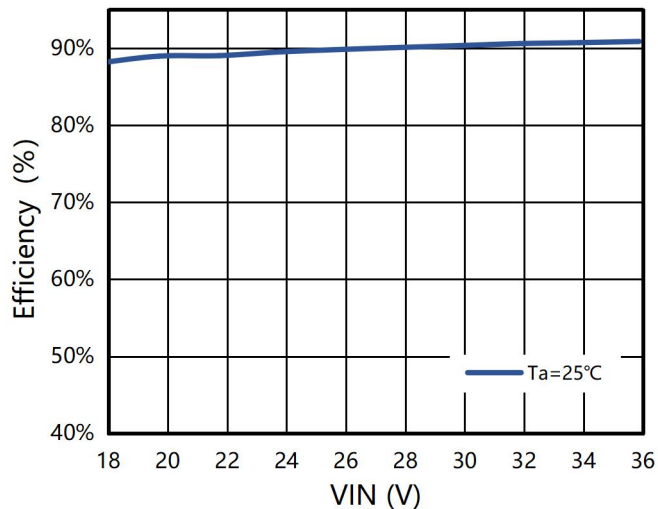


详细测试数据

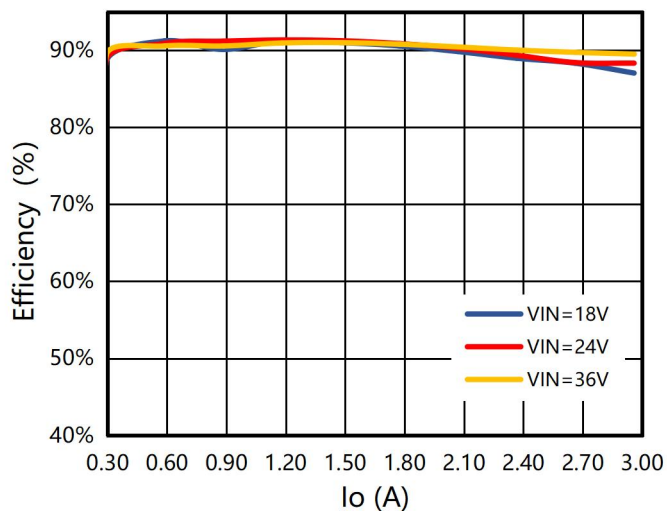
高低温测试曲线



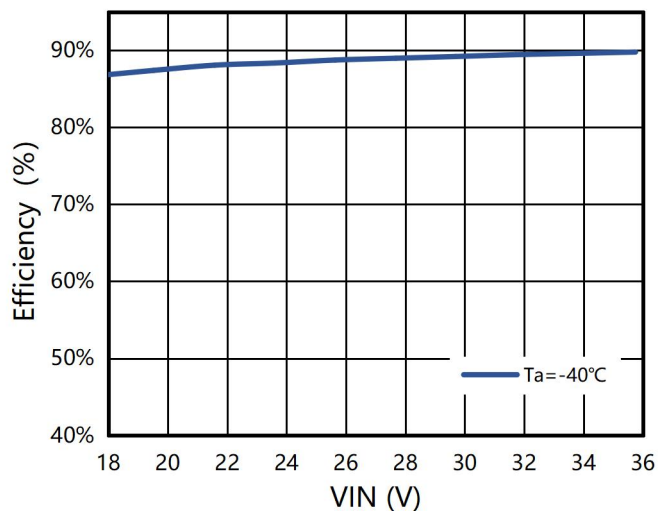
效率 VS 输出电流 (25°C)



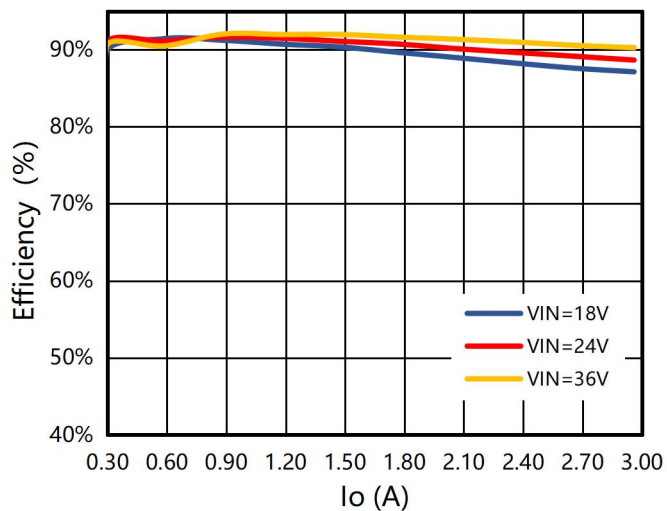
效率 VS 输入电压 (输出满载@25°C)



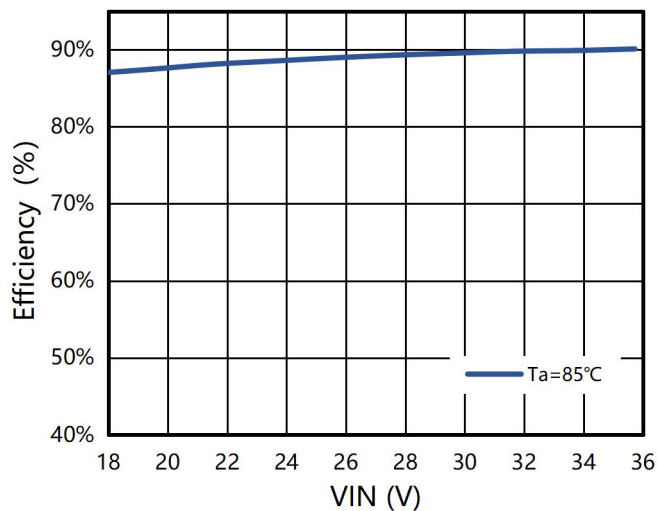
效率 VS 输出电流 (-40°C)



效率 VS 输入电压 (输出满载@-40°C)



效率 VS 输出电流 (85°C)



效率 VS 输入电压 (输出满载@85°C)

VIN=24V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
24.04	0.006	23.92	0	0%	0.00%
24.02	0.328	23.92	0.297	10%	90.17%
23.99	0.651	23.91	0.596	20%	91.25%
23.96	0.973	23.91	0.897	30%	92.00%
23.94	1.300	23.91	1.196	40%	91.88%
23.91	1.631	23.90	1.496	50%	91.68%
23.88	1.972	23.91	1.797	60%	91.24%
23.86	2.312	23.90	2.097	70%	90.85%
23.82	2.660	23.90	2.397	80%	90.42%
23.79	3.013	23.90	2.696	90%	89.89%
23.76	3.370	23.90	2.996	100%	89.43%

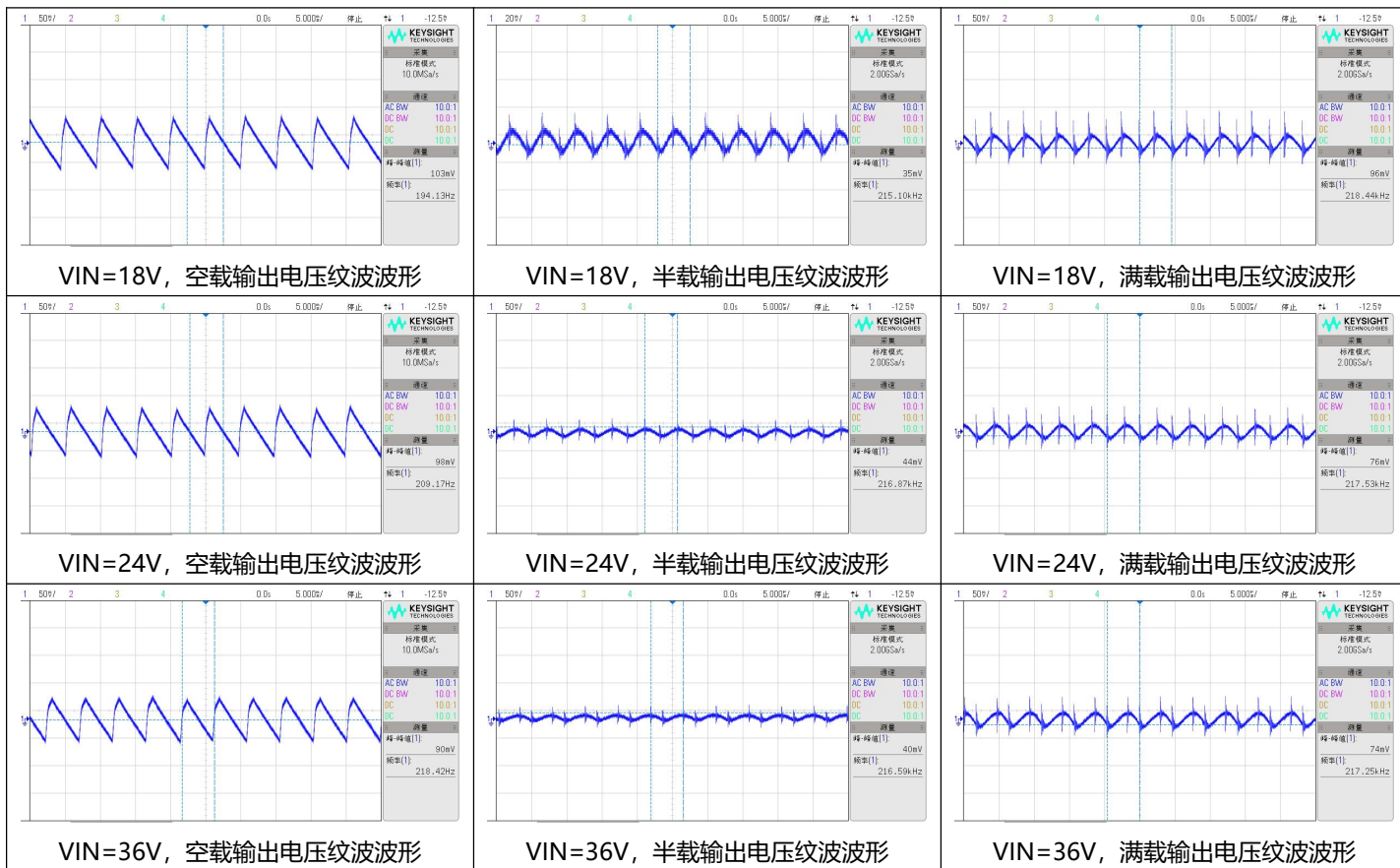
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
23.99	0.006	23.67	0	0%	0.00%
23.98	0.324	23.65	0.291	10%	88.58%
23.93	0.639	23.64	0.588	20%	90.90%
23.89	0.960	23.63	0.885	30%	91.18%
23.85	1.280	23.63	1.180	40%	91.34%
23.81	1.607	23.62	1.478	50%	91.24%
23.77	1.940	23.62	1.774	60%	90.87%
23.73	2.282	23.61	2.070	70%	90.25%
23.70	2.639	23.61	2.367	80%	89.35%
23.66	3.006	23.61	2.663	90%	88.40%
23.61	3.350	23.61	2.959	100%	88.33%

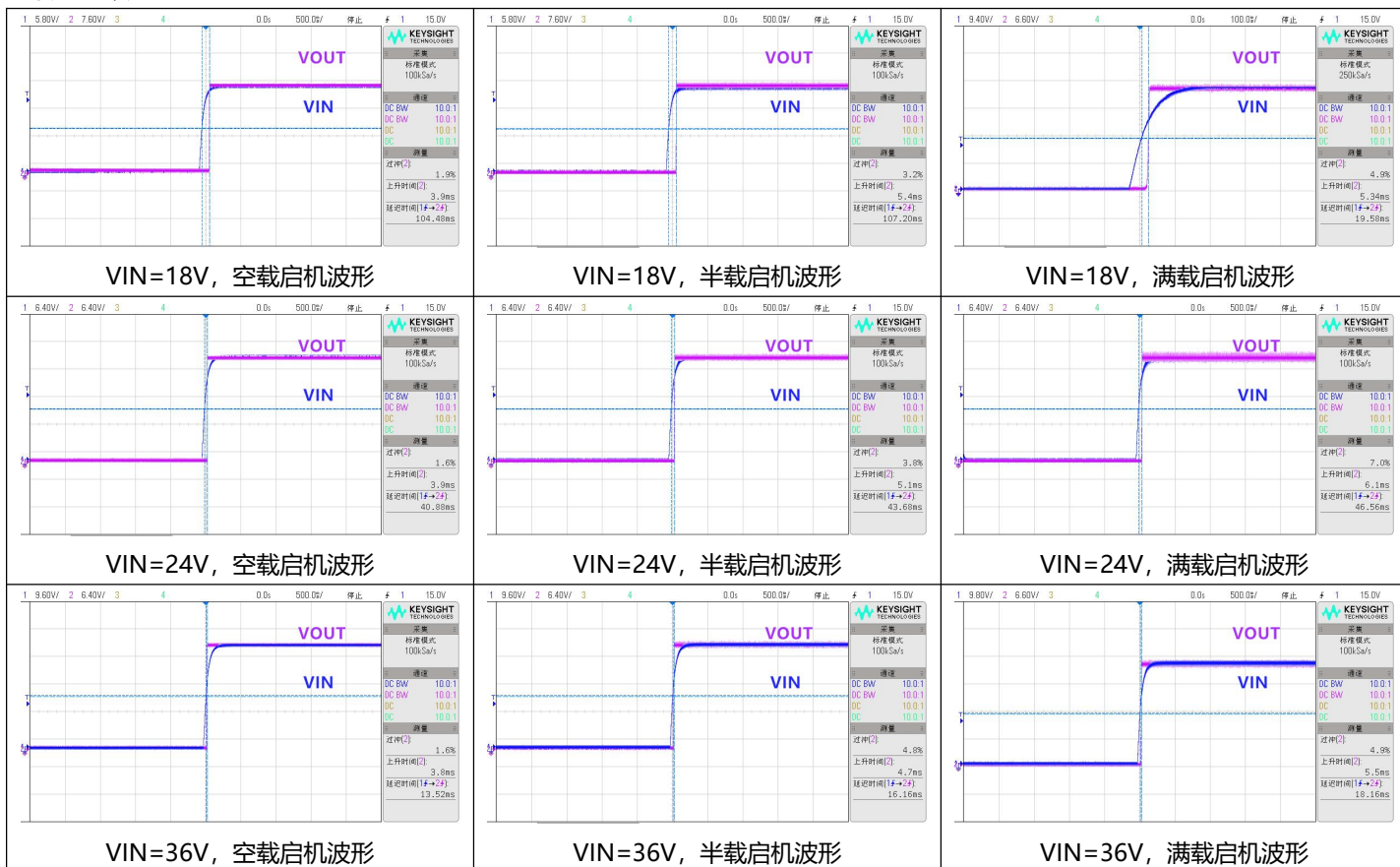
VIN=24V, Ta=85°C, 输入、输出及效率数据:

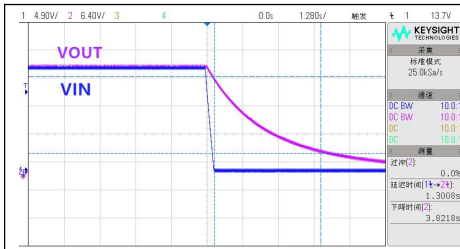
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
24.00	0.007	23.81	0	0%	0.00%
23.97	0.320	23.80	0.292	10%	90.60%
23.92	0.643	23.80	0.589	20%	91.14%
23.89	0.963	23.79	0.886	30%	91.62%
23.84	1.290	23.80	1.182	40%	91.47%
23.80	1.623	23.79	1.479	50%	91.09%
23.75	1.961	23.79	1.776	60%	90.72%
23.72	2.306	23.79	2.072	70%	90.12%
23.68	2.654	23.79	2.368	80%	89.64%
23.62	3.010	23.79	2.664	90%	89.14%
23.57	3.370	23.79	2.960	100%	88.65%

输出电压纹波波形

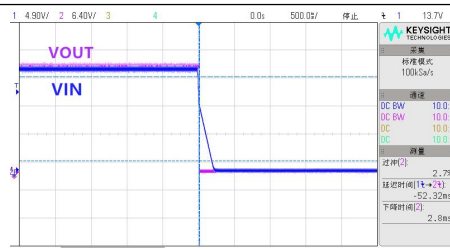


开关机波形

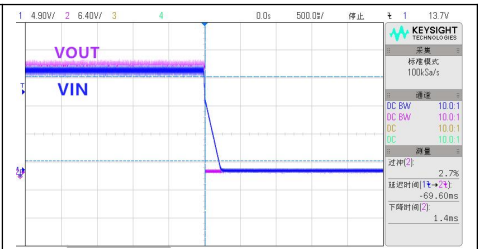




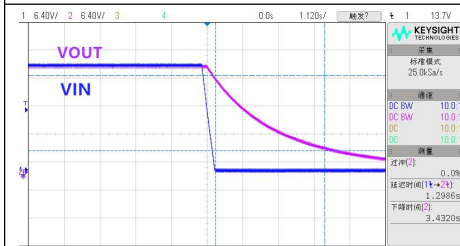
VIN=18V, 空载关机波形



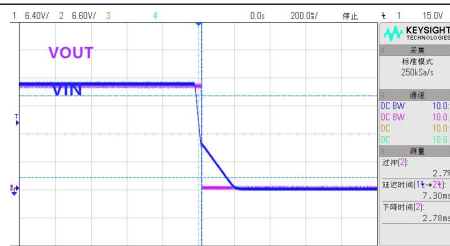
VIN=18V, 半载关机波形



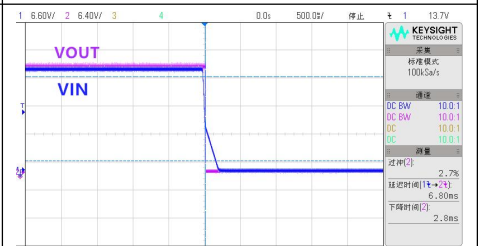
VIN=18V, 满载关机波形



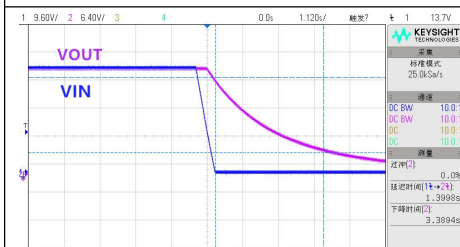
VIN=24V, 空载关机波形



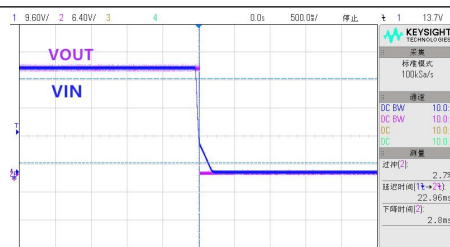
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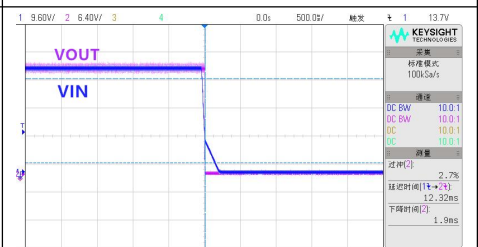
VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

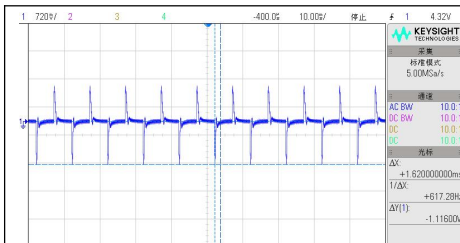


VIN=36V, 半载关机波形

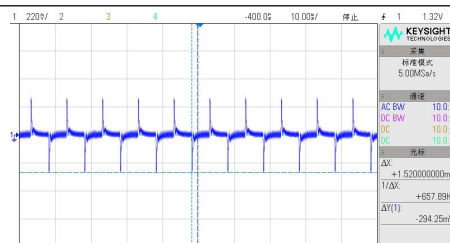


VIN=36V, 满载关机波形

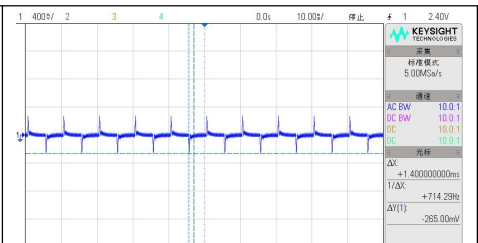
动态波形



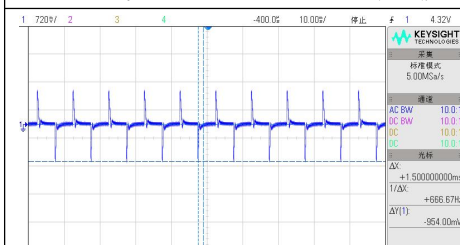
VIN=18V, 100%-10%-100%Io 动态波形



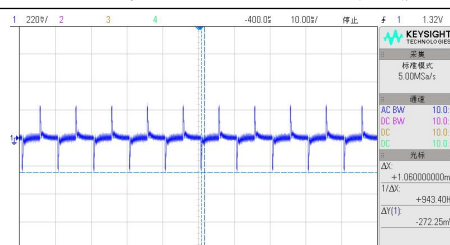
VIN=18V, 75%-50%-75%Io 动态波形



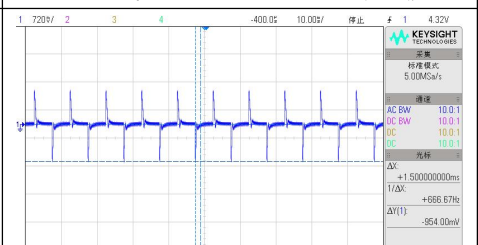
VIN=18V, 50%-25%-50%Io 动态波形



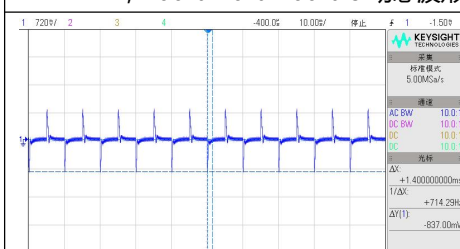
VIN=24V, 100%-10%-100%Io 动态波形



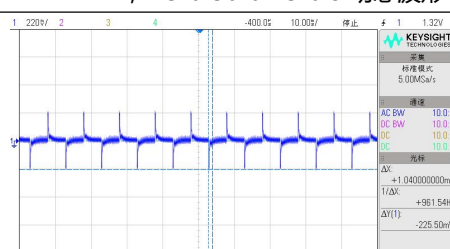
VIN=24V, 75%-50%-75%Io 动态波形



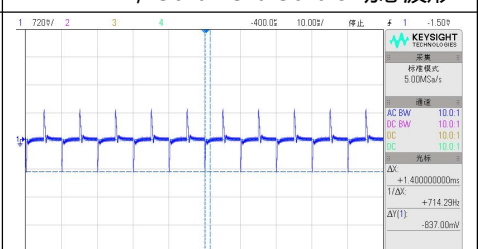
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

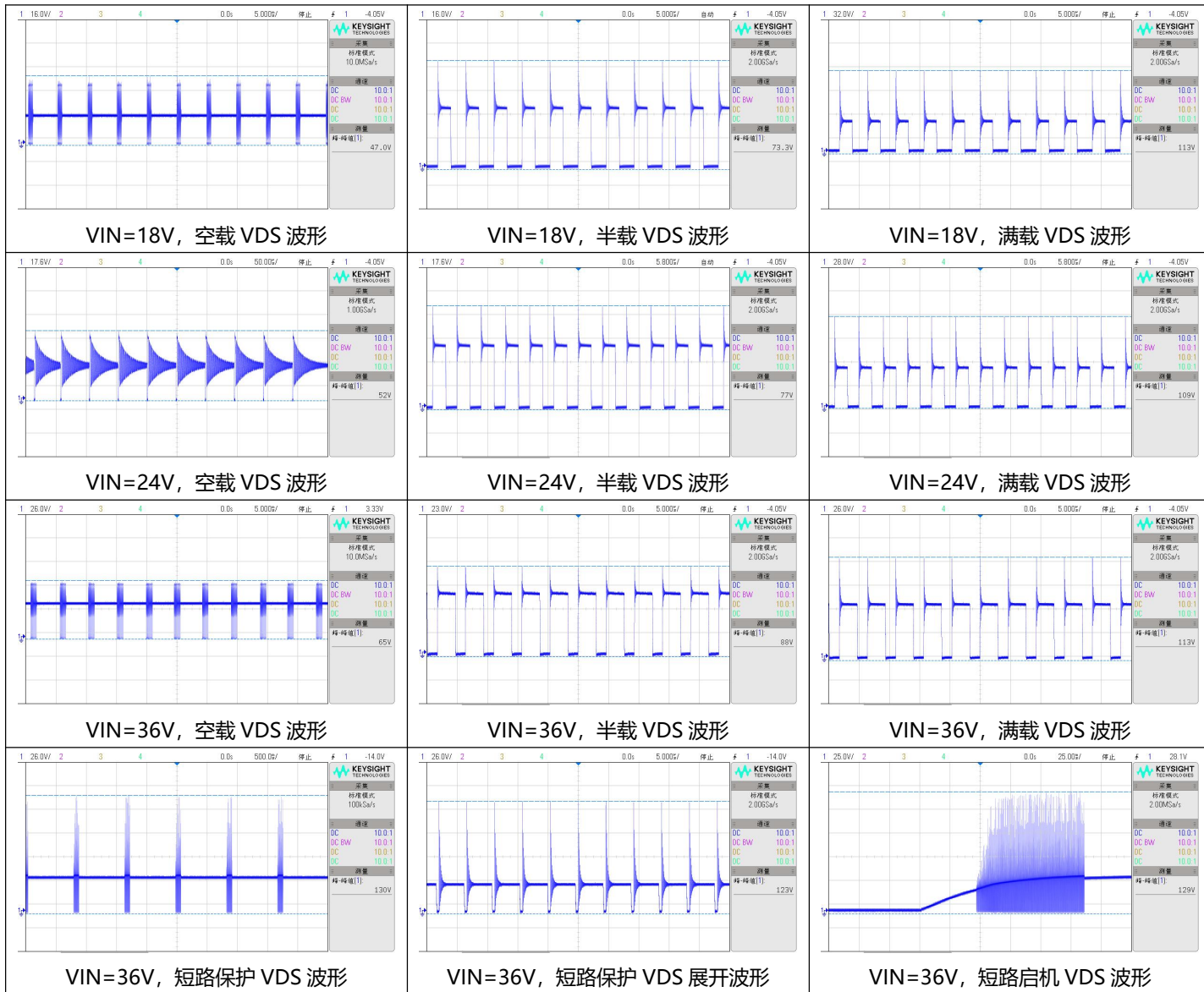


VIN=36V, 75%-50%-75%Io 动态波形

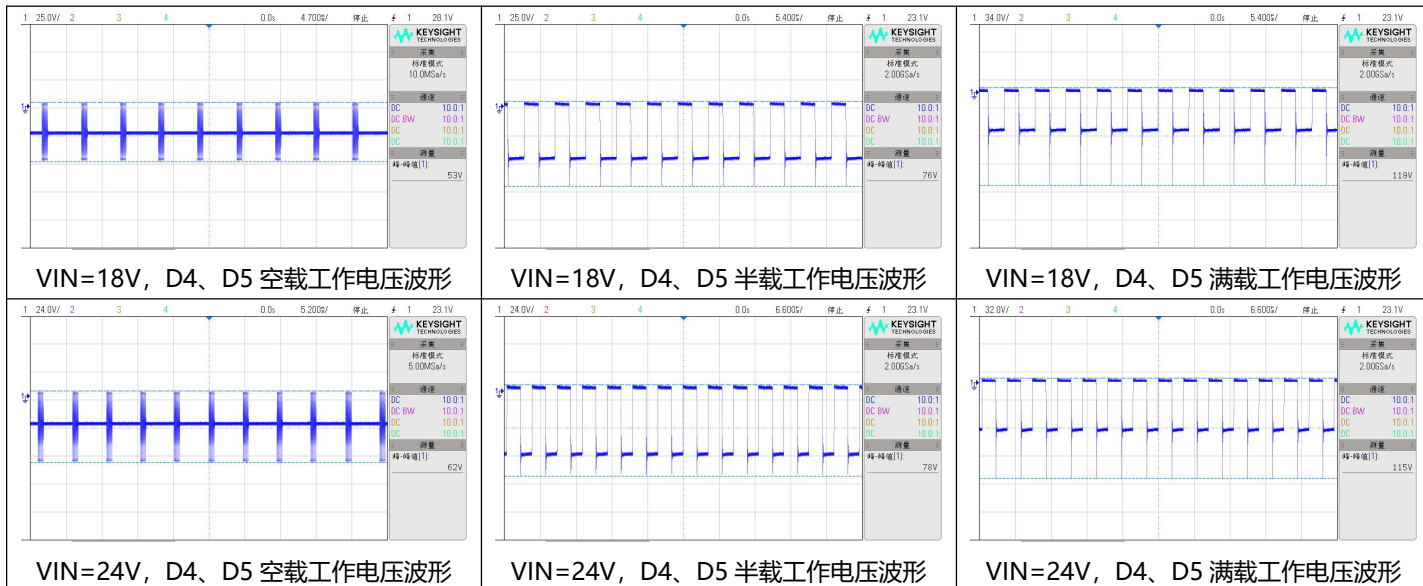


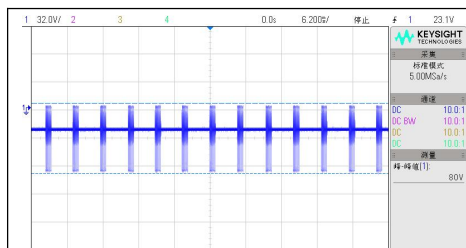
VIN=36V, 50%-25%-50%Io 动态波形

MOS 管电压应力波形

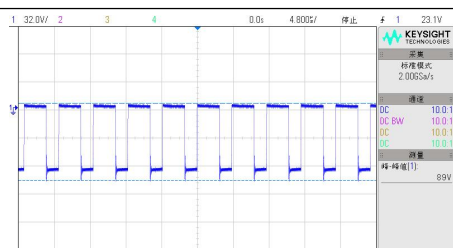


副边输出整流二极管 D4、D5 应力波形

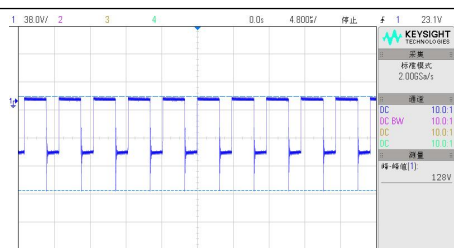




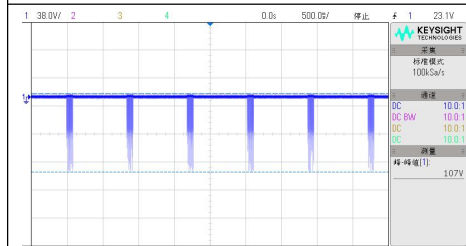
VIN=36V, D4、D5 空载工作电压波形



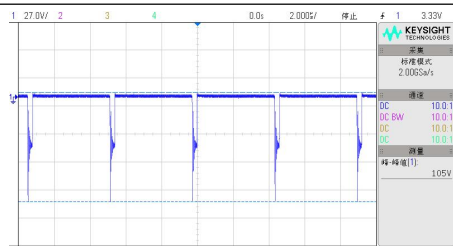
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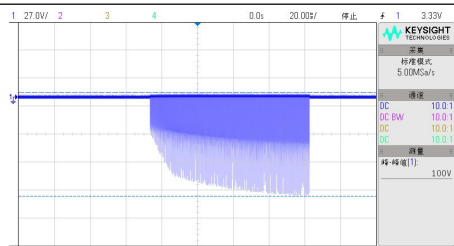
VIN=36V, D4、D5 满载工作电压波形



VIN=36V, D4、D5 短路保护电压波形



VIN=36V, D4、D5 短路保护电压展开波形



VIN=36V, D4、D5 短路启机电压波形

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